

Physically-Based Simulation

Final Presentation: Rube Goldberg Machine

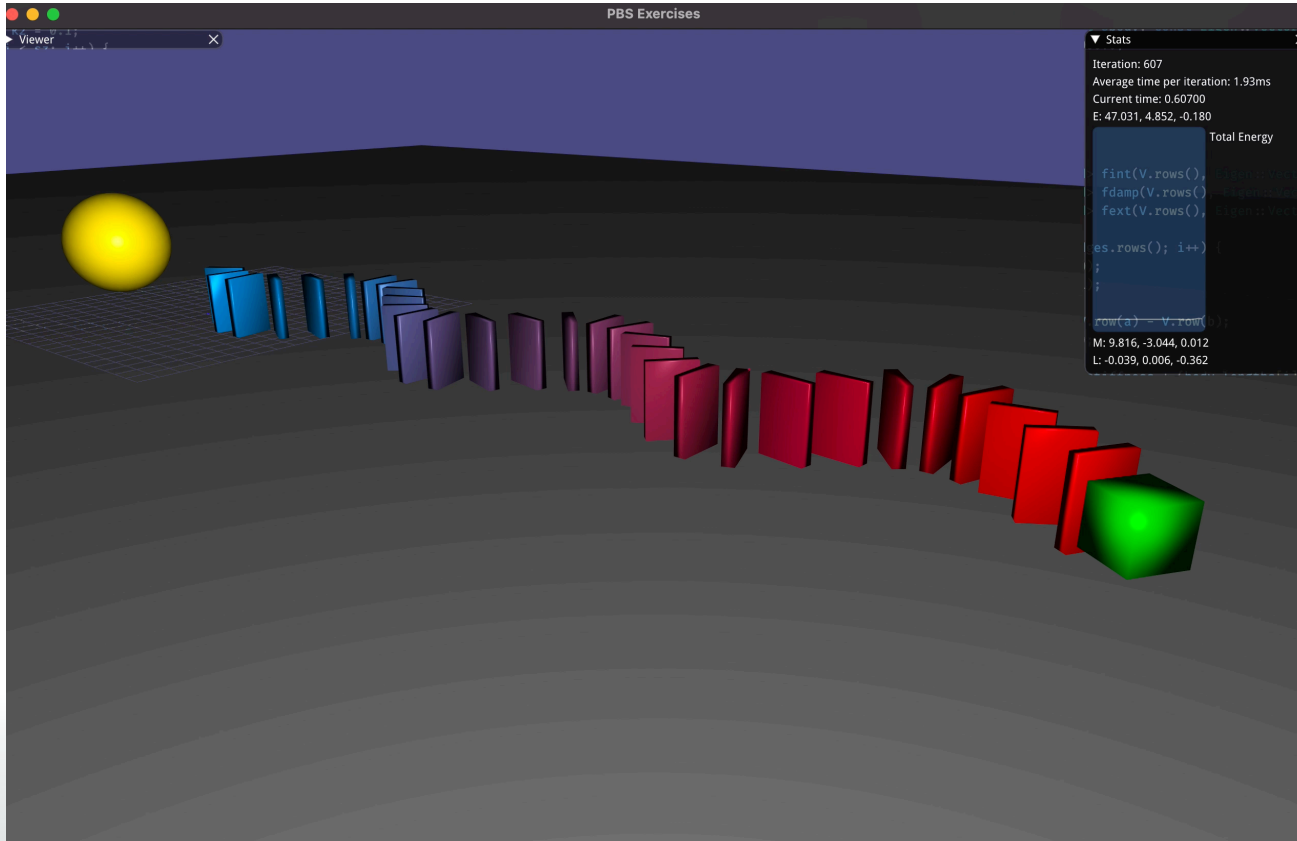
Group 19

Renato Semadeni

Simulation Methods

- Rigid Body Simulation
 - Sweep and Prune
 - GJK
 - EPA
- Baraff's Paper for Contact Forces and Friction
- Semi-Implicit Euler

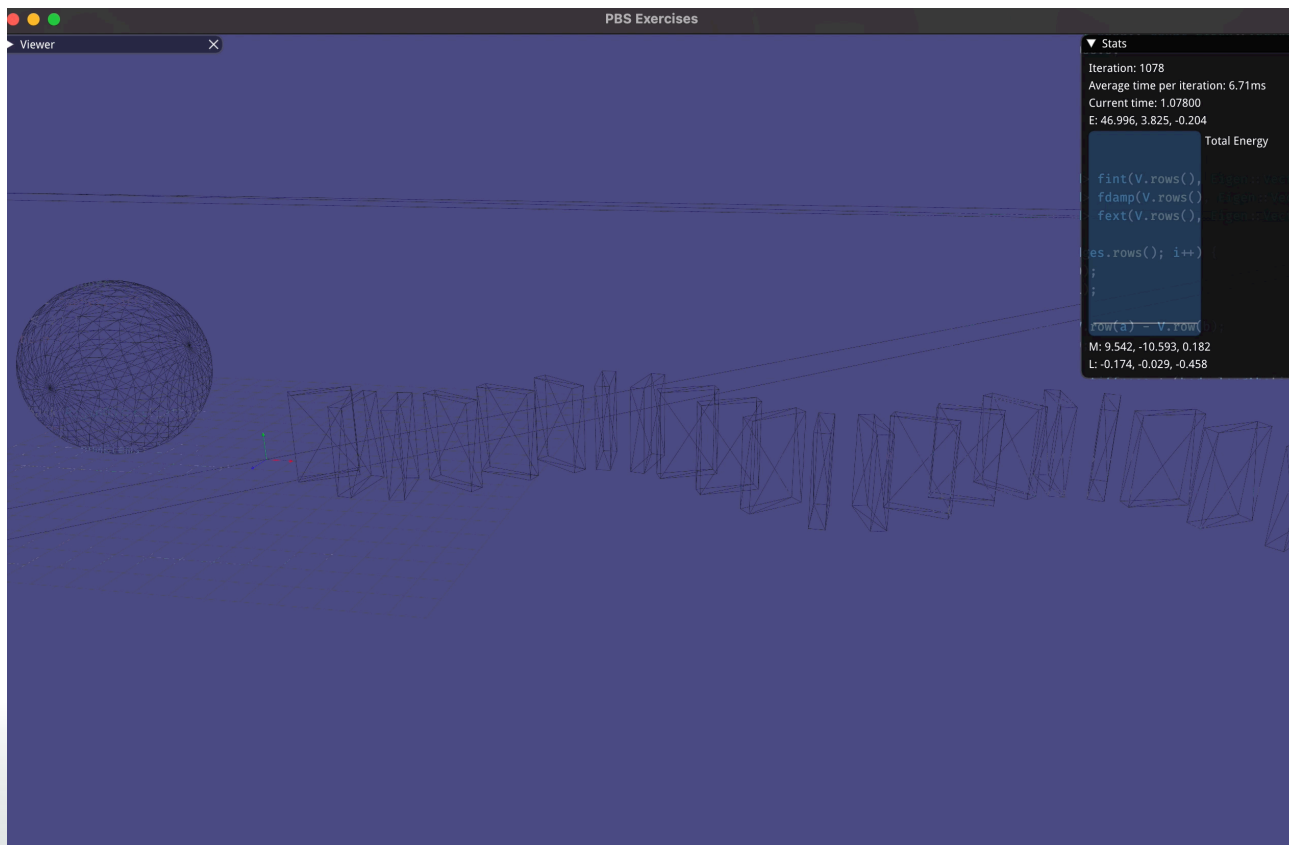
Current State



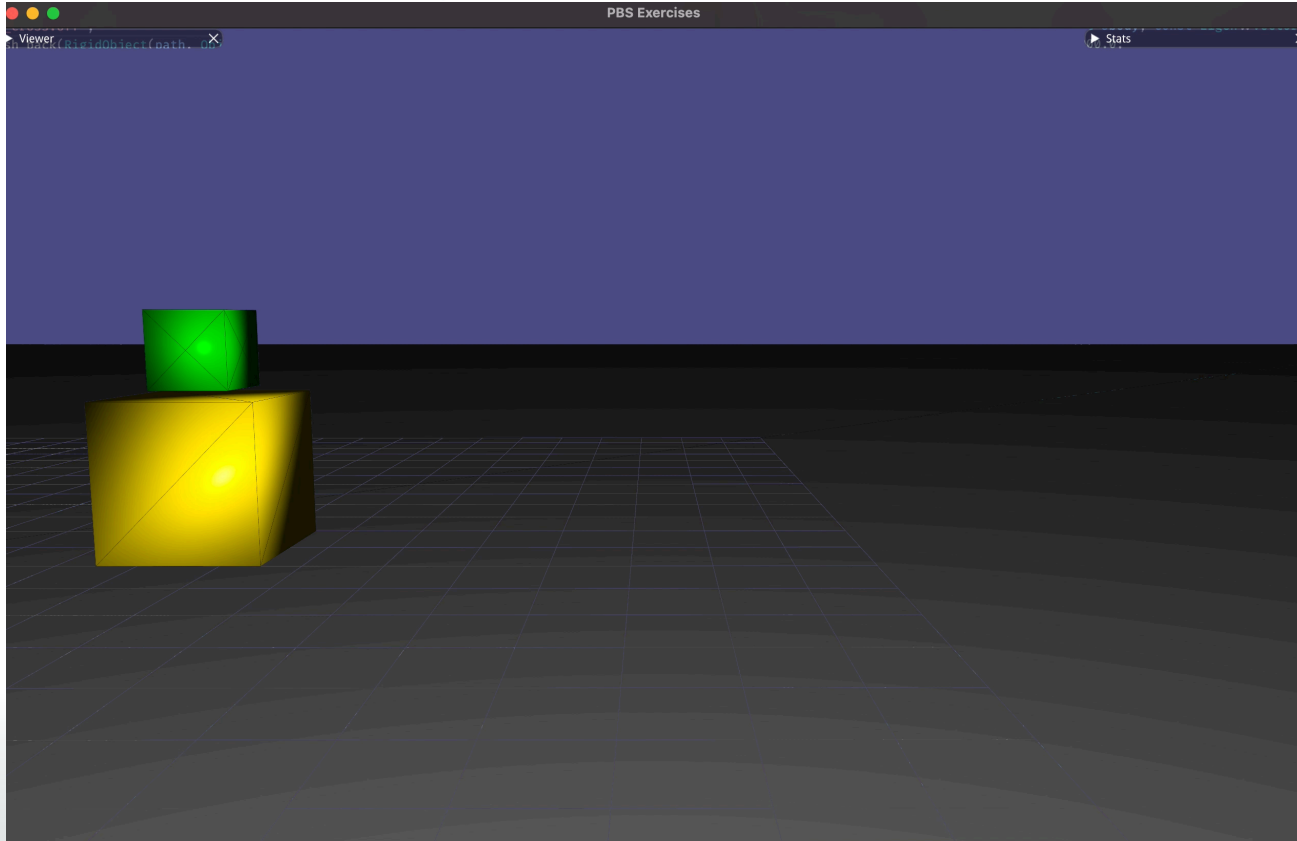
Achieved Milestones

1. put the objects on the screen ✓
2. add basic motion (falling domino stones) ✓
3. introduce multiple objects ✓
 1. Contact Force
 2. Simplistic Friction
4. connect basic sequence ✓
5. add soft body parts ✗ (not yet finished)
6. adding fluid effects

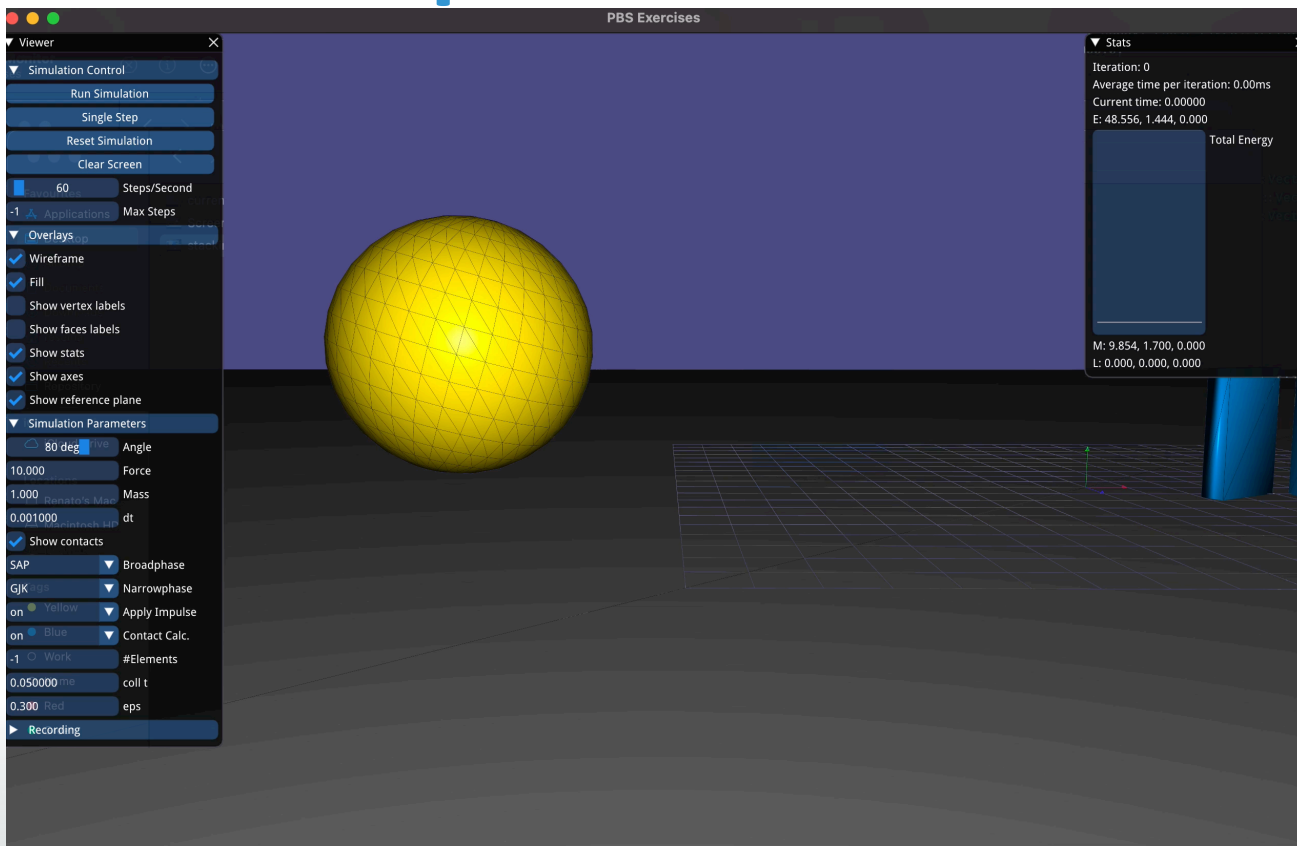
Collision and Contact Detection



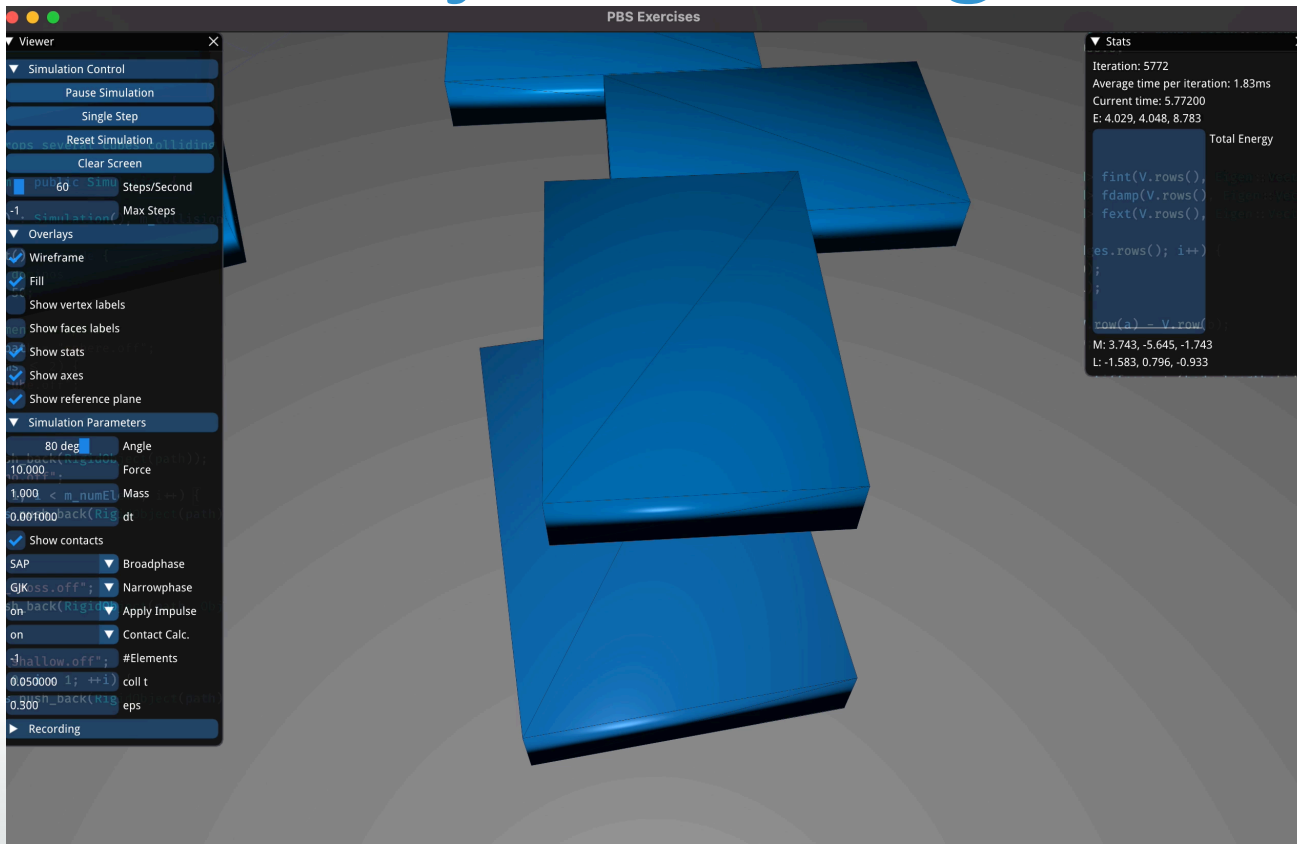
Simplistic Friction



Simplistic Friction



Object stacking



Isolated Stacking

The screenshot displays a 3D simulation environment titled "PBS Exercises". In the center, a green cube is stacked on top of a yellow cube. The interface includes several panels:

- Viewer**: Contains simulation controls such as "Run Simulation", "Single Step", "Reset Simulation", and "Clear Screen". It also features a "Steps/Second" slider set to 60 and a "Max Steps" field. Under "Overlays", options like "Wireframe", "Fill", "Show vertex labels", "Show faces labels", "Show stats", "Show axes", and "Show reference plane" are checked. The "Simulation Parameters" section includes fields for "Angle" (80 deg), "Force" (0.000), "Mass" (1.000), and "dt" (0.001000). Contact algorithms like "Broadphase", "Narrowphase", "Apply Impulse", and "Contact Calc." are also visible, along with "Recording" options.
- Stats**: A window on the right showing simulation statistics: "Iteration: 716", "Average time per iteration: 0.13ms", "Current time: 0.71600", and "E: -0.018, 0.972, 0.021". It also displays "Total Energy" with a code snippet:

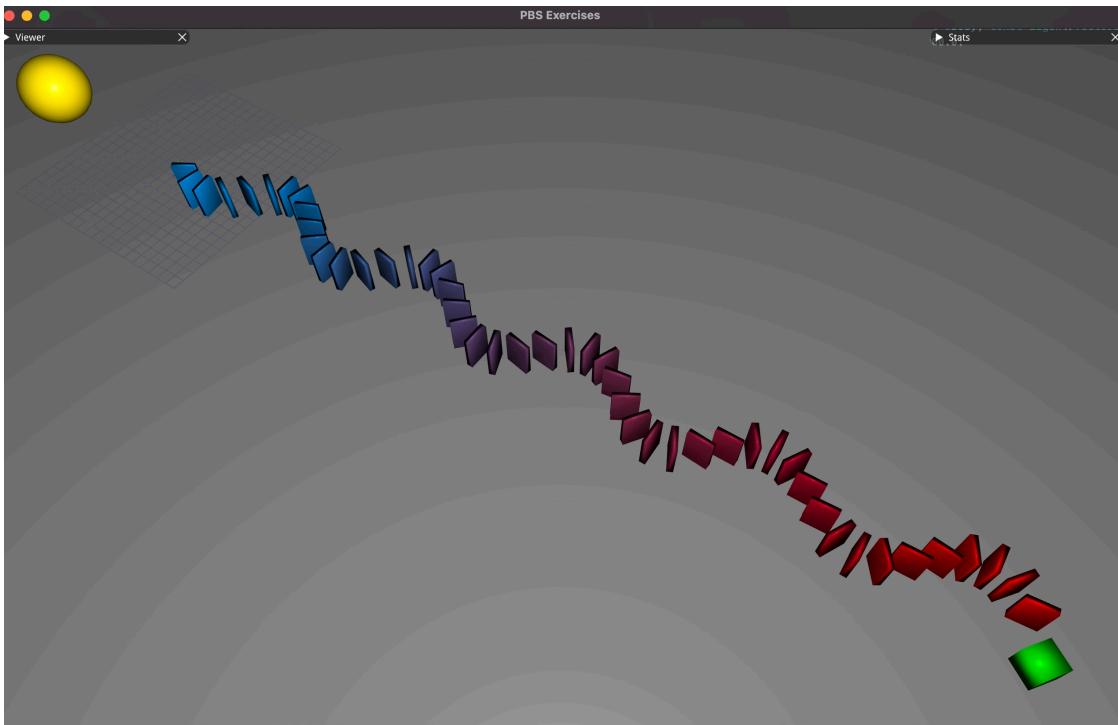
```
fint(V.rows(), ...);  
fdamp(V.rows(), ...);  
fext(V.rows(), ...);  
es.rows(); i++  
};  
row(a) = V.row(i);  
M: 0.000, -6.990, 0.000  
L: -0.036, 0.000, 0.042
```

Open & Remaining Issues

- Rigid Body Simulation
 - Static and Dynamic Friction
 - Object Stacking
- Soft Body Element
 - Helper Classes implemented, but no used so far

Summary

- Stability
 - Problems with stacking
 - Simplistic Friction induces energy
- Performance
 - Realtime
 - Not optimized



Questions?